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10/695,609

10/28/2003

Eiichi Iino

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EXAMINER

SONG, MATTHEW J

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte EIICHI LINO and
MASANORI KIMURA

Appeal 2008-1656
Application 10/695,609
Technology Center 1700

Decided: March 31, 2008

Before CHUNG K. PAK, CHARLES F. WARREN, and
PETER F. KRATZ, *Administrative Patent Judges*.

PAK, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 from the Examiner's refusal to allow claims 12 and 13. Claims 10 and 11, the other claims pending in the above-identified application, were indicated to be allowable by the Examiner. We have jurisdiction pursuant to 35 U.S.C. § 6.

STATEMENT OF THE CASE

The subject matter on appeal is directed to “a method for producing a silicon single crystal, wherein the silicon single crystal is grown by the Czochralski method...with or without performing necking operation...” (Spec. 1). Further details of the appealed subject matter are recited in representative claims 12 and 13 reproduced below:

12. A method for producing a silicon single crystal by the Czochralski method, comprising the steps of using a silicon seed crystal wherein oxygen concentration in the seed crystal is 12ppma (JEIDA) or less, bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, and growing a silicon single crystal without performing necking operation.

13. A method for producing a silicon single crystal by the Czochralski method, comprising the steps of using a silicon seed crystal which does not have a straight body portion but has a body shape selected from the group consisting of a cone shape, a pyramid shape, a cone shape whose side face is formed with a curved surface, a combined truncated cone and pyramid shape, and a combined truncated pyramid and cone shape, bringing a tip end of the seed crystal into contact with a silicon melt to melt the tip end of the seed crystal, and growing a silicon single crystal without performing necking operation.

The Examiner has relied upon the following references as evidence of unpatentability of the claimed subject matter:

Abe	5,911,822	Jun. 15, 1999
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Stanley Wolf, Ph.D et al. (Wolf), *Oxygen in Silicon*, Silicon Processing for the VLSI ERA, Vol. 1: Process Technology, Lattice Press, Sunset Beach, California, pp. 59-61 (1986).

The Appellants have relied upon the following reference as evidence of unobviousness of the subject matter recited in claim 12:

Iino	6,670,036 B2	Dec. 30, 2003
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The Examiner has rejected the claims on appeal as follows:

- 1) Claims 13 under 35 U.S.C. § 102(b) as anticipated by the disclosure of Abe; and
- 2) Claim 12 under 35 U.S.C. § 103(a) as unpatentable over the combined disclosures of Abe and Wolf.

The Appellants contend that the Examiner's rejections are not consistent with allowance of claims 10 and 11 in this application and of claims 1-6 of U.S. 6,670,036 B2 issued to Iino on December 30, 12003. The Appellants also contend that Abe does not teach employing a silicon seed crystal having no straight body portion. Accordingly, the Appellants appeal from the Examiner's decision rejecting the claims on appeal under 35 U.S.C. §§ 102(a) and 103.

*RELEVANT FACTUAL FINDINGS, PRINCIPLES OF LAW, ISSUES AND
ANALYSES*

I. *ANTICIPATION*

Under 35 U.S.C. § 102(b), anticipation is established only when a single prior art reference describes, either expressly or under the principle of inherency, each and every element of a claimed invention. *In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990). The law of anticipation, however, does not require that the prior art reference teach Appellant's purpose or utility

described in the Specification, but only that the claims on appeal “read on” something disclosed in the reference. *See Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 772 (Fed. Cir. 1983).

As correctly pointed out by the Appellants (Br. 12-13), Abe does not teach employing the claimed silicon seed crystal having no straight body. Abe teaches employing a silicon seed crystal having a truncated or sharp-pointed *tip end* in the form of a conical or pyramidal shape (col. 8, ll. 46-65). Abe illustrates a silicon seed crystal having such a sharp tip end and a straight body, but does not indicate that its silicon seed crystal has no straight body (Figures 2A-2D, together with col. 8, ll. 46-65). Accordingly, we concur with the Appellants that the Examiner has not established a prima facie case of anticipation within the meaning of 35 U.S.C. § 103(a).

II. OBVIOUSNESS

Under 35 U.S.C. § 103, the factual inquiry into obviousness requires a determination of: (1) the scope and content of the prior art; (2) the differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). “[A]nalysis [of whether the subject matter of a claim would have been obvious] need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *KSR Int’l Co., v. Teleflex, Inc.*, 127 S. Ct. 1727, 1740-41 (2007) *quoting In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006); *see also DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H.*

Patrick Co., 464 F.3d 1356, 1361 (Fed. Cir. 2006) (“The motivation need not be found in the references sought to be combined, but may be found in any number of sources, including common knowledge, the prior art as a whole, or the nature of the problem itself.”); *In re Bozek*, 416 F.2d 1385, 1390 (CCPA 1969) (“Having established that this knowledge was in the art, the examiner could then properly rely, as put forth by the solicitor, on a conclusion of obviousness ‘from common knowledge and common sense of the person of ordinary skill in the art without any specific hint or suggestion in a particular reference.’”); *In re Hoeschele*, 406 F.2d 1403, 1406-07 (CCPA 1969) (“[I]t is proper to take into account not only specific teachings of the references but also the inferences which one skilled in the art would reasonably be expected to draw therefrom . . .”).

There is no dispute that Abe teaches a method of producing a silicon single crystal by the Czochralski method involving contacting the tip end of a silicon seed crystal with a silicon melt to at least partially melt the tip end thereof and growing a silicon single crystal without performing necking operation. Compare Ans. 4, with Br. 10-11. Nor is there any dispute that Wolf teaches a typical Czochralski silicon seed crystal having an oxygen concentration of 10-20 ppma. See Ans. 4 with Br. 10-11. Indeed, the Appellants do not even question the Examiner’s determination at page 4 of the Answer that:

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Abe et al by using a seed crystal having an oxygen concentration between 10-20 ppma, as taught by Wolf et al. to obtain a sufficiently strong seed crystal for pulling a single crystal silicon ingot.

Rather, the Appellants contend that Abe and Wolf do not teach the claimed silicon seed crystal having no straight body (Br. 10). However, claim 12, unlike claim 13, does not require the employment of a silicon seed crystal having no straight body. *In re Self*, 671 F.2d 1344, 1348 (CCPA 1982) (Appellants' arguments fail from the outset because they are not based on limitations appearing in the claims.).

The Appellants also contend that this rejection is not consistent with the allowance of claims 10 and 11 of the present application and claims 1-6 of U.S. 6,670,036 B2 issued to Iino on December 30, 2003 (Br. 10-11). However, it is well settled that each case must be determined based on its own merits. *In re Giolito*, 530 F.2d 397, 400 (CCPA 1976) ("We reject appellants' argument that the instant claims are allowable because similar claims have been allowed in a patent. It is immaterial whether similar claims have been allowed to others."). This is especially true in this case since all facts in evidence in this case are different from those previously considered in determining the patentability of the claims of U.S. 6,670,036. Moreover, claims 10 and 11 of the current application have a limitation different from claim 12 of the current application.

Accordingly, we concur with the Examiner that one of ordinary skill in the art would have been led to employ the claimed silicon seed crystal having the claimed oxygen content in the process taught by Abe with a reasonable expectation of successfully growing a single silicon crystal within the meaning of 35 U.S.C. § 103.

Pursuant to 37 C.F.R. § 41.50(b), we enter new grounds of rejection against claims 10 through 13 under 35 U.S.C. § 103(a).

Claims 11 and 13 are rejected under 35 U.S.C. § 103 as unpatentable over the disclosure of Abe.

Abe teaches a method of producing a silicon single crystal by the Czochralski method, comprising contacting a silicon seed crystal, whose tip end has a sharp-pointed shape or truncation thereof in the form of cone or pyramid, with a silicon melt to at least partially melt the tip end portion thereof and then growing a silicon single crystal without performing necking operation (col. 2, l. 60 to col. 3, l. 8 and col. 8, ll. 23-64). Abe also teaches that the silicon single crystal can be grown by performing conventional necking operation as well (col. 5, ll. 1-5, col. 6, ll. 11-64 and col. 10, ll. 24-37). Although Abe does not specifically mention a silicon seed crystal having no straight body as required by claims 11 and 13, it can be inferred from the disclosure of Abe that the tip end portion, not the straight body portion, of its silicon seed crystal is critical in growing a silicon single crystal. Specifically, Abe teaches (col. 5, ll. 8-21 and col. 8, ll. 23-32) that:

When a seed crystal comes into contact with silicon melt, the tip end of the seed crystal is partially melted and the seed crystal joins with the silicon melt, thereby enabling subsequent crystal growth...(col. 5, ll. 8-21)

....

This operation is possible because of the following reasons. Even when a seed crystal is brought into contact with silicon melt and is melted from a state in which it is separated from the silicon melt, heat shock does not act on the seed crystal upon contact with the silicon melt, due to a small area and a small heat capacity of the portion to first come into contact with the silicon melt. Further, since the contact area increases gradually due to a subsequent slow lowering of the seed crystal, no steep temperature gradient is formed within the seed crystal during the melting.

In other words, Ab teaches that the tip end portion (only partially melted) of a seed crystal is sufficient to carry out subsequent crystal growth. Thus, it would have been obvious to one of ordinary skill in the art to remove the straight body portion of Abe's silicon seed crystal to eliminate the additional cost associated with the extended length of the unused seed crystal, with a reasonable expectation of successfully growing a silicon single crystal from partially melting the tip end portion thereof without slip dislocation.

In re Thompson, 545 F.2d 1290, 1294 (CCPA 1976) ("Eliminating the cost of the preliminary step of wax impregnation would have been sufficient motivation of doing so."); *see also In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975); *In re Larson*, 340 F.2d 965, 969 (CCPA 1965). This is especially true in this case since Abe also teaches that the use of seed crystal holders is known in growing a silicon single crystal (col. 5, ll. 14-17).

Claims 10 and 12 are rejected under 35 U.S.C. § 103 as unpatentable over the combined disclosures of Abe and Wolf.

As indicated above, Abe teaches a method of producing a silicon single crystal by the Czochralski method wherein the sharp-pointed tip end of a silicon seed crystal is brought into contact with a silicon melt to partially melt the tip end thereof. Abe also teaches growing a silicon single crystal after partially melting the tip end of the silicon seed crystal, with or without performing necking operation. Abe does not mention the oxygen concentration level of the silicon seed crystal employed as required by claims 10 and 12. However, Wolf teaches that a typical Czochralski silicon crystal as having an oxygen concentration of 10-20 ppma as an impurity (p. 59). Wolf also teaches reducing the oxygen impurity level to less than 6 ppma (p. 61).

Wolf teaches that the presence of the high oxygen content in the silicon crystal can cause a large dislocation whereas small clusters of dispersed oxygen can strengthen the crystal (*id.*).

Given the disadvantage of a high concentration of oxygen impurity in a silicon crystal, we determine that one of ordinary skill in the art would have been led to employ a silicon seed crystal having the low oxygen content, e.g., 6 ppma, to grow a silicon single crystal having low oxygen impurity. *See also In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003) (In cases involving overlapping ranges, we and our predecessor court have consistently held that even a slight overlap in range establishes a *prima facie* case of obviousness.”)

ORDER

The decision of the Examiner is affirmed-in-part and two new grounds of rejection are entered.

TIME PERIOD

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED AND § 41.50(b)

tf/lr

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Appeal 2008-1656
Application 10/695,609

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